

WHAT IS CLAIMED IS:

1. A legged mobile robot which comprises at least lower limbs and an upper part of a body disposed above the lower limbs, and which is movable by the movement of the lower limbs, wherein the legged mobile robot further comprises:

means for determining whether or not the robot has fallen down;

means for determining the posture of the robot when the robot has fallen down; and

means for executing a getting-up operation pattern in accordance with the fallen-down posture.

2. A legged mobile robot which comprises at least lower limbs and an upper part of a body disposed above the lower limbs and possessing a predetermined movement allowing degree of freedom at a trunk, and which is movable by the movement of the lower limbs, wherein the legged mobile robot further comprises:

means for determining whether or not the robot has fallen down;

means for determining the posture of the robot when the robot has fallen down; and

means for executing a getting-up operation pattern in

accordance with the fallen-down posture.

3. A legged mobile robot which comprises at least lower limbs and an upper part of a body disposed above the lower limbs and possessing a predetermined movement allowing degree of freedom at a trunk, and which is movable by the movement of the lower limbs, wherein the legged mobile robot further comprises:

means for determining whether or not the robot has fallen down; and

means for executing a getting-up operation pattern involving at least a displacement in correspondence with the movement allowing degree of freedom at the trunk, when the robot has fallen down.

4. A legged mobile robot according to Claim 3, wherein the trunk possesses at least a movement allowing degree of freedom in a pitch axis direction, and wherein the getting-up operation pattern uses the movement allowing degree of freedom in the pitch axis direction of the trunk.

5. A legged mobile robot according to Claim 3, wherein the trunk possesses at least a movement allowing degree of freedom in a yaw axis direction, and wherein the getting-up operation pattern uses the movement allowing degree of

freedom in the yaw axis direction of the trunk.

6. A legged mobile robot according to Claim 3, wherein the trunk possesses at least a movement allowing degree of freedom in a roll axis direction, and wherein the getting-up operation pattern uses the movement allowing degree of freedom in the roll axis direction of the trunk.

7. A legged mobile robot which comprises at least lower limbs and an upper part of a body disposed above the lower limbs and possessing a predetermined movement allowing degree of freedom at a trunk, and which is movable by the movement of the lower limbs, wherein the legged mobile robot further comprises:

means for determining whether or not the robot has fallen down;

means for determining the posture of the robot when the robot has fallen down; and

means for executing an operation pattern for changing to another fallen-down posture when the robot has fallen down.

8. A legged mobile robot according to Claim 7, wherein the trunk possesses at least a movement allowing degree of freedom in a pitch axis direction, and wherein the operation

pattern for changing to another fallen-down posture uses the movement allowing degree of freedom in the pitch axis direction of the trunk.

9. A legged mobile robot according to Claim 7, wherein the trunk possesses at least a movement allowing degree of freedom in a yaw axis direction, and wherein the operation pattern for changing to another fallen-down posture uses the movement allowing degree of freedom in the yaw axis direction of the trunk.

10. A legged mobile robot according to Claim 7, wherein the trunk possesses at least a movement allowing degree of freedom in a roll axis direction, and wherein the operation pattern for changing to another fallen-down posture uses the movement allowing degree of freedom in the roll axis direction of the trunk.

11. An operation controlling method for a legged mobile robot which comprises at least lower limbs and an upper part of a body disposed above the lower limbs, and which is movable by the movement of the lower limbs, the method comprising the steps of:

determining whether or not the robot has fallen down;
determining the posture of the robot when the robot has

fallen down; and

executing a getting-up operation pattern in accordance with the fallen-down posture.

12. An operation controlling method of a legged mobile robot which comprises at least lower limbs and an upper part of a body disposed above the lower limbs and possessing a predetermined movement allowing degree of freedom at a trunk, and which is movable by the movement of the lower limbs, the method comprising the steps of:

determining whether or not the robot has fallen down;
determining the posture of the robot when the robot has fallen down; and

executing a getting-up operation pattern in accordance with the fallen-down posture.

13. An operation controlling method of a legged mobile robot which comprises at least lower limbs and an upper part of a body disposed above the lower limbs and possessing a predetermined movement allowing degree of freedom at a trunk, and which is movable by the movement of the lower limbs, the method comprising the steps of:

determining whether or not the robot has fallen down;
and

executing a getting-up operation pattern involving at

least a displacement in correspondence with the movement allowing degree of freedom at the trunk, when the robot has fallen down.

14. An operation controlling method of a legged mobile robot according to Claim 13, wherein the trunk possesses at least a movement allowing degree of freedom in a pitch axis direction, and wherein the getting-up operation pattern uses the movement allowing degree of freedom in the pitch axis direction of the trunk.

15. An operation controlling method of a legged mobile robot according to Claim 13, wherein the trunk possesses at least a movement allowing degree of freedom in a yaw axis direction, and wherein the getting-up operation pattern uses the movement allowing degree of freedom in the yaw axis direction of the trunk.

16. An operation controlling method of a legged mobile robot according to Claim 13, wherein the trunk possesses at least a movement allowing degree of freedom in a roll axis direction, and wherein the getting-up operation pattern uses the movement allowing degree of freedom in the roll axis direction of the trunk.

17. An operation controlling method of a legged mobile robot which comprises at least lower limbs and an upper part of a body disposed above the lower limbs and possessing a predetermined movement allowing degree of freedom at a trunk, and which is movable by the movement of the lower limbs, the method comprising the steps of:

 determining whether or not the robot has fallen down;
 and

 executing a getting-up operation pattern for changing to another fallen-down posture when the robot has fallen down.

18. An operation controlling method according to Claim 17, wherein the trunk possesses at least a movement allowing degree of freedom in a pitch axis direction, and wherein the operation pattern for changing to another fallen-down posture uses the movement allowing degree of freedom in the pitch axis direction of the trunk.

19. An operation controlling method according to Claim 17, wherein the trunk possesses at least a movement allowing degree of freedom in a yaw axis direction, and wherein the operation pattern for changing to another fallen-down posture uses the movement allowing degree of freedom in the yaw axis direction of the trunk.

20. An operation controlling method according to Claim 17, wherein the trunk possesses at least a movement allowing degree of freedom in a roll axis direction, and wherein the operation pattern for changing to another fallen-down posture uses the movement allowing degree of freedom in the roll axis direction of the trunk.

21. An operation controlling method for controlling the operation of a legged mobile robot when the robot has fallen down in a lying-on-the-face posture, the robot comprising at least lower limbs and an upper part of a body disposed above the limbs and possessing a predetermined movement allowing degree of freedom at a trunk, and being movable by the movement of the lower limbs, the method comprising the steps of:

causing the robot to take a posture where only arms and the legs contact a floor by using at least a movement allowing degree of freedom at a trunk pitch axis;

moving the center of gravity of the legged mobile robot upward by using at least the movement allowing degree of freedom at the trunk pitch axis;

decreasing relative positions where portions of the arms and corresponding portions of the legs contact a floor by using at least the movement allowing degree of freedom at

the trunk pitch axis; and

as a result of moving the portions of the arms which contact the floor and the corresponding portions of the legs which contact the floor sufficiently close to each other, starting extending the whole body in response to the entrance of a ZMP of the legged mobile robot into an area where the feet contact the floor.

22. An operation controlling method for controlling the operation of a legged mobile robot when the robot has fallen down in a lying-on-the-back posture, the robot comprising at least lower limbs and an upper part of a body disposed above the lower limbs and possessing a predetermined movement allowing degree of freedom at a trunk, and being movable by the movement of the lower limbs, the method comprising the steps of:

causing the robot to take a posture where the upper part of the body is raised by using at least a movement allowing degree of freedom at a hip joint pitch axis;

moving the center of gravity of the legged mobile robot forward by using at least a movement allowing degree of freedom at a trunk pitch axis; and

as a result of moving the center of gravity sufficiently forward, starting extending the whole body in response to the entrance of a ZMP of the legged mobile robot

into an area where the feet contact a floor.

23. An operation controlling method for controlling the operation of a legged mobile robot when the robot has fallen down in a lying sideways posture, the robot comprising at least lower limbs and an upper part of a body disposed above the lower limbs and possessing a predetermined movement allowing degree of freedom at a trunk, and being movable by the movement of the lower limbs, the method comprising the step of:

causing the robot to take a lying-on-the-face posture by using at least a movement allowing degree of freedom at a trunk yaw axis.

24. An operation controlling method for controlling the operation of a legged mobile robot when the robot has fallen down in a lying sideways posture, the robot comprising at least lower limbs and an upper part of a body disposed above the lower limbs and possessing a predetermined movement allowing degree of freedom at a trunk, and being movable by the movement of the lower limbs, the method comprising the steps of:

causing the upper part of the body of the robot to be raised from the surface of a floor by using a movement allowing degree of freedom at a trunk roll axis; and

causing the robot to take a lying-on-the-face posture by using a movement allowing degree of freedom at a trunk yaw axis.

25. An operation controlling method for controlling the operation of a legged mobile robot when the robot has fallen down in a lying-on-the-back posture, the robot comprising at least lower limbs and an upper part of a body disposed above the lower limbs and possessing a predetermined movement allowing degree of freedom at a trunk, and being movable by the movement of the lower limbs, the method comprising the step of:

causing the robot to take a lying sideways posture by using at least a movement allowing degree of freedom at a trunk yaw axis.

26. An operation controlling method for controlling the operation of a legged mobile robot when the robot has fallen down in a fallen-down posture, the robot comprising at least lower limbs and an upper part of a body disposed above the lower limbs and possessing a predetermined movement allowing degree of freedom at a trunk, and being movable by the movement of the lower limbs, the method comprising at least one of the steps of:

(a) changing the posture of the robot from a lying-on-

the-back posture to a lying sideways posture;

(b) changing the posture of the robot from the lying sideways posture to a lying-on-the-face posture;

(c) changing the posture of the robot from the lying-on-the-face posture to the lying sideways posture; and

(d) changing the posture of the robot from the lying sideways posture to the lying-on-the-back posture.